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Strip mining overburden removal method

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(56) Related Art
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Abstract

(Figure 23)

A strip mining method is disclosed where a dragline is employed for excavating a strip of predetermined maximum width followed by excavating subsequently progressively narrower strips followed by a further wide strip to minimise spoil height and re-handling. The method is used to mine single seams and multiple seams with either matching or staggered strips and where multiple seams are mined. The method is applicable to thick overburden/thin interburden or thick overburden/thick interburden multiple seam mining.

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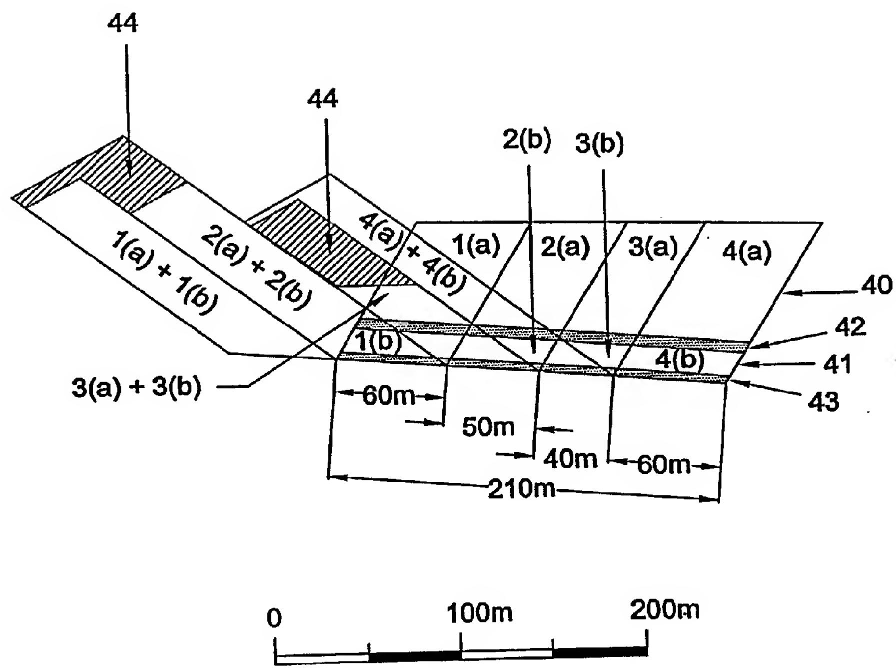

FIGURE 23

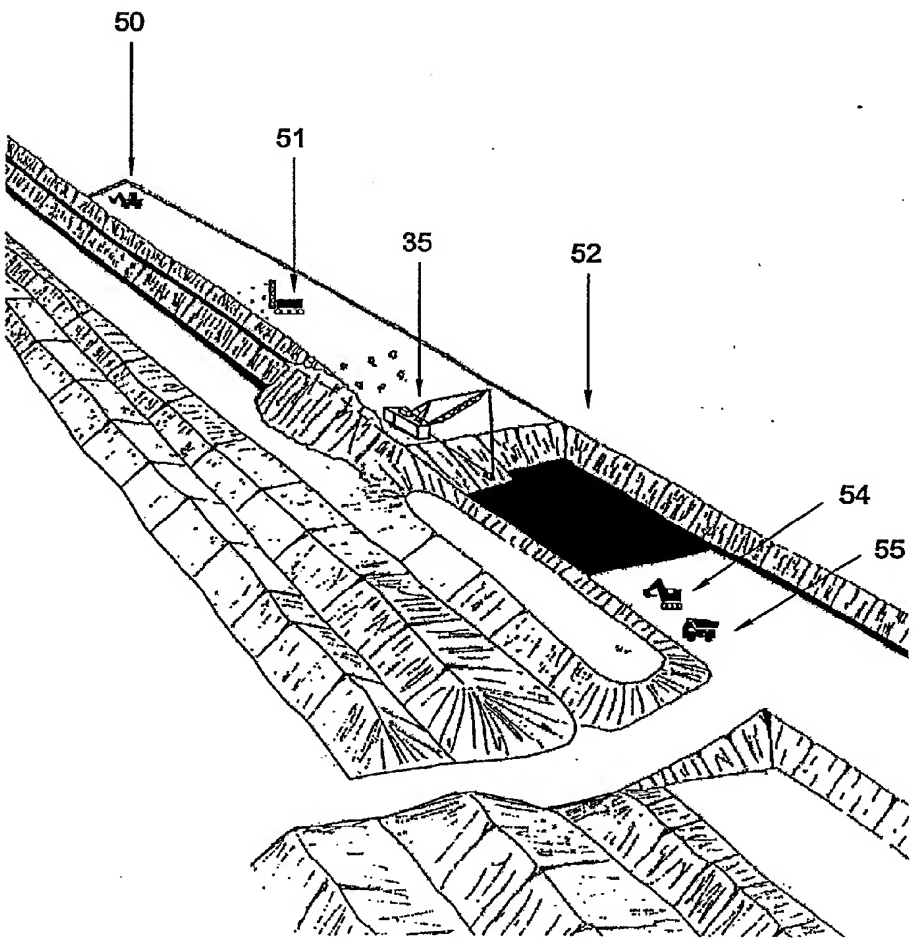

FIGURE 24

AUSTRALIA
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COMPLETE SPECIFICATION
FOR A STANDARD PATENT

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Invention Title:	STRIP MINING OVERBURDEN REMOVAL METHOD

The following statement is a full description of this invention, including the best method of performing it known to us:

This invention relates to a strip mining overburden removal method.

The invention will be described by way of example with a strip mining method for uncovering coal. It should be appreciated that strip mining overburden removal may also be employed in the mining of material other than coal.

Strip mining for extracting coal in an open cut mine is carried out employing draglines as the primary earthmoving tool around which the entire economics of a mine may be developed. Draglines are employed to expose the coal seam so that coal may be extracted. The physical size and geometry of the dragline and the mechanical components such as motors, winch drums and rope lengths govern the digging characteristics and limits to which a particular dragline may dig and to which it may raise the bucket to dump its contents on or above a spoil pile.

Draglines work within geometrical constraints and are able to dig to predetermined design depths. In general, draglines are constrained to work within the following operating parameters: dig depth, dump height and operating radius.

Most draglines have a typical limit of 40m to 50m depth to which it may dig and a dump height of between 40m to 45m and a reach of approximately 85m from the centre of the dragline tub. More recent draglines have been constructed which are able to dig to depths of between 60m to 70m. Utilising conventional dragline methods and dig depth and dump height as indicated above, draglines can operate to depths of approximately 60 metres incurring moderate amounts of re-handling of waste material. To operate to depths greater than 60 metres, excessive re-handle volumes and other operational difficulties such as the need to construct dragline access ramps, cause the process to be less economical. Current excavation technology would allow for the introduction of a prestrip fleet to remove waste material in advance of the dragline, so that a manageable depth is left for the dragline.

In strip coal mining, an area of the mine is prepared by truck/shovel waste removal so that a coal seam is covered by overburden no thicker than the maximum depth to which the dragline may dig and the dragline is then employed

in a strip mining technique to cut down to the seam in a strip having a predetermined width and a length typically between 500m to 3000m. The width of the strip is dependent upon the operating characteristics of the dragline. The width of the strip is typically between 55m to 70m and adjacent strips of a constant width are cut to progressively expose more coal for removal. The overburden is removed and dumped in a spoil pile to one side of the working strip, and this is typically into the previously mined strip. Some re-handling of the overburden material is often required for digging any strip.

Conventional strip mining techniques are used to expose a single coal seam having a relatively shallow dip, in mining two seams having a thick overburden and a thin interburden between the seams and in mining two seams with an overburden depth greater than the maximum dragline digging depth and a thick interburden between the seams.

Strip mining a relatively shallow dipping single seam may involve a two pass dragline digging method incorporating throw blasting. On a first pass along the strip, the dragline excavates a high wall along the strip using a variety of normal proven dragline digging methods and waste is used to construct an inpit bench ahead of the direction of movement of the dragline along the strip. The inpit bench is built to be as low as possible to allow the dragline to reach down to the seam and to minimise re-handling of waste but not too low so as to limit the ability of the dragline to effectively build a spoil pile on a final pass along the strip.

Extra material from the high wall side of the strip may be required in order to build the inpit bench to the correct width and position in preparation for the second dragline pass along the strip. In the second pass along the strip, the strip is successively widened to expose the seam with the waste being dumped onto the spoil pile on one side of the strip opposite the high wall area. The coal edge is cleaned up and a final low wall is constructed. The pit or strip width is typically 60m.

The coal is removed from the exposed seam and an adjacent strip is excavated to produce a further strip of an identical width. The waste removed from the further strip is dumped into the previously mined strip. Thus, some re-

handling of waste is often necessary in order to excavate each subsequent strip.

If the single seam does not have a shallow dip then the quantity of overburden which needs to be removed is substantially greater and the excavation method may be more complex than that mentioned above.

Where there are two seams with a thick overburden and a thin interburden between seams, the strip mining method currently used is as follows. The interburden may have a thickness of 10m to 20m and the overburden may partially be removed to bring the thickness of the combined overburden and interburden thickness down to the sort of thickness which may be excavated efficiently by a dragline. Truck/shovel excavation may be employed for this purpose.

After blasting of the overburden, the dragline executes several operations. In a first pass the dragline excavates a key cut in an upper high wall. The waste is swung around behind the dragline in order to prepare a working pad. The dragline exposes the upper seam and the waste is used to build a bridge out into the pit and the edge of the upper seam is established. The dragline then excavates the interburden material using several passes of the dragline to expose the coal

Further strips of constant width are excavated and because the waste expands, not all of the waste from the next strip may be dumped into and be received in the previously excavated and mined strip. Thus for each successive strip, some additional re-handling of waste is necessary to allow subsequent strips to be excavated.

Where there are two seams with a thick overburden and a thick interburden between the seams current strip mining involves first removing some of the overburden employing truck/shovel excavation until the overburden and the interburden together have a combined thickness not exceeding the maximum digging depth of the dragline. Typically, overburden having a depth of about 15m is left after the truck/shovel excavation of some of the overburden and the interburden typically may have a maximum thickness of about 45m. A plurality of strips or pits of constant width are progressively excavated with the dragline making multiple passes along each strip until the seams are exposed. The waste

is dumped in a spoil pile into a previously mined strip. The dragline is required to re-handle some of this material to build a suitable shaped pile so that both the coal seams are uncovered for mining. Truck/shovel excavation is continuously performed to ensure that only about 15m of overburden remains over the upper seam.

With known strip mining methods for relatively shallow dipping single seam mining, for two seam mining where thin overburden and thin interburden exists or where there is a thick overburden conventional dragline methods include re-handling of waste in each strip. This re-handling of waste has an impact on the cost involved in strip mining.

It is an object of the present invention to provide a strip mining method which manages re-handling and allows digging to greater depths.

According to one aspect, the invention provides a strip mining overburden removal method for use in strip mining of single or multiple seam deposits, the method including excavating waste with a dragline from a strip of predetermined maximum width in one or more passes of the dragline along the strip and dumping the waste into a previously mined strip to build a spoil pile, mining a deposit or deposits in the strip exposed by excavating the waste, excavating waste with the dragline from subsequent strips of progressively narrower width and dumping the waste into an adjacent previously mined strip to build a spoil pile and mining the deposit or deposits from the strips and, after a predetermined minimum width strip is excavated either by the dragline and/or by truck and shovel and mining coal or coal and partings from the minimum width strip, excavating a further strip of a predetermined maximum width and dumping the waste into the previously mined strip.

Where the minimum width strip is excavated by the dragline the method may include dumping of the waste to form a spoil pile and re-handling of the waste with the dragline in the spoil pile to make room for waste excavated from the next maximum width strip. Alternatively, truck and shovel excavation or excavation using other equipment may be used to remove material from the spoil pile (rather than dragline re-handling) or from one of the strips, (preferably from the maximum width strip) to provide for proper waste material management for

the next excavation step.

Where there is re-handling employing the dragline it is preferred that the re-handling step includes re-handling in the spoil pile after the minimum width strip is excavated.

Where truck/shovel excavation is employed to excavate waste from the strip of maximum width, the waste may simply be carted away from the pit and dumped at a convenient location rather than onto the adjacent spoil pile. In this way dragline spoil re-handling is avoided.

Whilst the width difference between adjacent strips may be any desired width it is preferred that there be a width difference of between 15m to 5m between adjacent strips. The difference in width between adjacent strips may be dependant upon the dip angle of the seam of the deposit being mined. Thus if the seam dip alters, the method may involve non-uniform width changes from one strip to the next. Typically a 5m change in width from one seam to the next may be chosen where the seam being mined is substantially horizontal. Where the seam being mined has a dip angle other than horizontal, the difference in width between adjacent strips may be greater than 5m and may be 10m for example.

The maximum strip width is dependent upon the particular dragline being employed in the method of the invention. Typically, the widest strip is between 60m to 70m although a width outside this range is not excluded.

The minimum strip width is also dependent upon the particular dragline employed in the method of the invention. Typically, the minimum strip width is between 30m to 40m although a width outside these limits is not excluded.

The number of strips excavated and mined in a sequence between a maximum width strip and a minimum width strip is dependant on the difference in width between adjacent strips and other factors. Typically 2, 3, 4 or 5 strips are excavated after a maximum width strip before the sequence is repeated and another maximum width strip is excavated. The number of strips could be greater than 5 strips.

The method of the invention may include blasting overburden prior to the excavation of waste from each strip. Depending on whether a single seam of a

deposit or a double seam of a deposit is being mined, blasting may either be cast blasting or stand-up blasting or combinations of these.

When the method of the invention is used for mining multiple seams of a deposit it is preferred that in-pit benches are constructed on which the dragline may work during excavation of the waste from the strip.

In single seam mining the total overburden thickness removed by the dragline may be up to 80m or greater.

In multiple seam mining it may be necessary for some of the overburden to be removed to ensure that the remaining overburden and the interburden together do not have a combined thickness exceeding the maximum thickness of waste which may be excavated by a particular dragline. Typically, where multiple seams are being mined the combined overburden and interburden thickness removed by the dragline may be up to about 80m or greater.

In a multiple seam where there is a thick interburden between the seams, the method of the invention may function adequately if some of the overburden is removed by a truck/shovel excavation for example to leave a total of overburden and interburden removed by the dragline of up to about 80m or greater.

In single and multiple seam mining according to the invention it is preferred that part of the re-handling of waste before a further strip of predetermined maximum width is excavated involves spoil pullback to provide room in the spoil pile for waste from the next wide strip.

Where the method involves multiple seam mining and the strips excavated from above the upper seam are staggered relative to the strips excavated from above the lower seam, it is preferred that most or all of the waste above the upper minimum width seam be removed by truck and shovel excavation. Some pre-stripping of waste from the other strips above the upper seam is carried out so that the combined depth of the remaining overburden and the interburden between the seams does not exceed dragline capabilities.

Particular preferred embodiments of the invention will now be described by way of example with reference to the drawings in which:

Figures 1 through 4 show various stages of excavating a strip in a single

seam arrangement in a mine of a width less than a previously excavated and mined strip;

Figures 5 through to 9 show various stages of excavating a strip in a mine subsequent to the strip excavated in Figures 1 to 4;

Figures 10 through to 14 show various stages of excavating a strip in a mine subsequent to the strip excavated in Figures 5 to 9;

Figures 15 and 16 show details of waste re-handling after the coal exposed in Figure 14 is mined;

Figures 17 through to 21 show stages of waste excavation after the re-handling of waste in Figures 15 and 16 to once again allow a strip of the width of something approximating the width of the strip in Figure 1; and

Figure 22 is a view showing the spoil pile configuration after the excavation of Figure 21 is completed and before the exposed seam is mined;

Figure 23 is a view showing excavating according to an embodiment of the invention for mining two seams with a thick overburden above the upper seam and a thin interburden between the seams;

Figures 24 and 25 show a representation of two steps in the excavating method of Figure 23; and

Figure 26 is a view showing excavating according to an embodiment of the invention for mining two seams with a thick over burden above the upper seam and a thick interburden between the seams; and

Figure 27 is a view showing a mining method according to another embodiment of the invention.

In Figure 1 a spoil pile 30 is shown to one side of a previously excavated and mined seam of coal having a predetermined maximum width determined by operating extremes of the dragline employed for performing the excavating. In this figure the maximum width of the strip from which exposed coal of seam 31 has been removed is shown as 55 m. A high wall 32 of a depth of 61.8m is shown on the left hand side of the figure. Throw or cast blasting is performed for moving waste material 1 into the old void of a 55m width previously mined strip. Before a subsequent strip of a width less than the adjacent previously mined maximum width strip (in this case 50m in width) may be excavated to expose the

coal in the seam 31, the waste which has been blast cast must be excavated by the dragline and deposited to one side of the strip of reduced width and adjacent to the spoil pile 30.

As shown in Figure 2 a dozer 34 is used to provide a bench on the cast blast waste on which the dragline may work as it progresses along the strip when excavating the waste. The dragline 35 in Figure 3 is shown working on the bench produced by the dozer 34 to remove some of the waste and to deposit that waste adjacent the spoil pile 30 to extend the spoil pile.

Before the dragline 35 may be moved to the higher level on the spoil pile as shown in Figure 4, the dozer is employed to produce a higher bench and the dragline is moved to the higher bench. From this higher position the strip may be excavated to expose the coal in a second or subsequent strip to the strip of the greatest width. The table and the legend identifies waste area types in the figure. At least two passes of the dragline along the strip are necessary to excavate each strip.

Figure 5 shows the mine condition after the coal exposed in Figure 4 is mined. Further blasting is performed to throw waste into the second strip just mined and a third subsequent strip is then excavated. The third strip has a width less than the width of the second strip. After cast blasting a dozer 34 is used to provide a bench on which the dragline 35 may work to excavate the waste in the third strip. This is shown in Figure 6. Figure 7 shows the waste over the third strip after the bench has been produced. Figure 8 shows how the dragline excavates part of the third strip in a pass along the strip. The waste is dumped onto the spoil pile. The table and the legend provides an indication of area types in the waste and spoil pile.

To allow the dragline to perform a second pass along the strip as shown in Figure 9 the dozer produces a higher bench in the spoil pile and the dragline moves to that higher bench and along that higher bench to complete excavating the waste from the third strip. Once the waste in the third strip is excavated and the coal in that strip is exposed, the coal may be mined.

Figure 10 shows how a fourth strip subsequent to the strip mined in Figure 9 may be excavated. The fourth strip is of a width less than the third strip.

The high wall 32 is once again cast blast to spill as much waste as is possible into the previously mined strip as shown in Figure 10. A bench is cut with a dozer 34 in the cast blast waste as shown in Figure 11. The dragline 35 then excavates waste in a first pass along the strip as shown in Figures 12 and 13. The tables and the legends in Figures 12 and 13 indicate waste area types. A second bench is produced at a higher level and the dragline moves to the higher bench and completes fourth strip as shown in Figure 14 until the coal in the seam 31 is exposed for mining. The table and the legend in Figure 14 identify waste area types produced by the dragline as it excavates the strip and dumps the waste onto the spoil pile 30. The coal exposed in this strip is then mined.

Once a strip of a predetermined minimum width is produced, further smaller width strips are not excavated. The predetermined minimum width is dependant upon the particular dragline used to perform the excavating, seam dip and other factors which make the excavating of smaller width strips impractical or unfeasible.

The next step in the method of the invention involves excavating a strip having once again the predetermined maximum width. However, before this can be done some re-handling of waste in the spoil pile is necessary to provide space in the pile for the extra waste produced in excavating a wider strip than the one just mined. This is because the adjacent strip of predetermined minimum width alone cannot accommodate all of the waste which must be removed to expose coal in the strip of maximum width which is now being excavated.

The method of the invention, where it is employed to mine coal from a single seam, only requires major spoil re-handling after the smallest strip in the sequence is mined and an additional minor re-handling during the excavation of the wide strip rather than each time during the excavation of a strip as is the case in known strip mining in single seam situations. By excavating and mining a series of successively narrower strips, the waste from one strip is readily accommodated in a spoil pile built over a previously mined larger width strip with reduced dragline re-handle. Major additional re-handling need only be performed in this embodiment of the invention before another strip of the predetermined maximum width is excavated.

Figure 15 shows the manner in which the waste in the spoil pile 30 may be re-handled prior to excavating another strip of the predetermined maximum width. A dozer 34 is employed to provide a bench in the pile 30 as shown in Figure 15. Figure 16 shows how the dragline 35 located on the bench is used to provide room for the waste produced from the next large width excavation strip which is excess to that which cannot adequately be accommodated in the minimum width strip just mined.

Figures 17 to 21 show how a strip of maximum predetermined width is excavated after a strip of minimum predetermined width is mined and the major spoil re-handling has been completed.

Cast blasting is carried out in the high wall 32 to throw as much waste as possible over the mined minimum width strip and against the spoil pile 30 as shown in Figure 17. As shown in Figure 18, a dozer 34 is used to produce a bench on which the dragline may travel in a first pass along the strip. The dragline 35 is then used to excavate some of the waste and to dump that waste onto the spoil pile as shown in Figure 19. The bench which is produced as a consequence of the re-handling in Figure 16 prior to commencement of excavation of the wide strip is then used as shown in Figure 20 and the dragline is used to re-handle waste during the excavation process in this wide strip to make room for more waste as the remainder of the wide strip is excavated. The situation shown in Figure 22 is then achieved.

The method of the invention as well as being suitable for strip mining of single seams of material and in maximising efficiency in mining by using the dragline to the best of its capacity and capability may also be used for strip mining multiple seams.

The conventional technique used to mine a double seam with a thick overburden and a thin interburden is as follows. A stand-up blast profile is employed in the overburden above the upper seam and in a first pass of the dragline along the strip an in pit bench is established. This in pit bench is extended. The upper coal seam is exposed and mined. The in pit bench is then removed to expose the lower seam and the waste removal involves high hoisting low productivity re-handling. Where the overburden is deeper than a depth that

can be handled by the dragline, the interburden removal requires two dragline passes along the strip which requires considerable re-handling, deep digging and high hoisting of waste and this is undesirable. The strips that are excavated are of a constant width with the width being determined by many factors including dragline digging and hoisting capabilities.

The method of the invention employed in a two seam situation with thick overburden and thin interburden is illustrated generally in Figure 23. For the sake of a convenience of description the handling of waste in some of the passes along the strips has been omitted.

The overburden 40 in the strips above the upper seam 42 has been identified as 1(a), 2(a), 3(a) and 4(a) whilst the interburden in the strips between the seams is identified as 1(b), 2(b), 3(b) and 4(b). At least two dragline passes are necessary to remove the overburden in each strip and at least two dragline passes are necessary to remove the interburden in each strip to allow both seams to be mined.

The dragline excavating is such that the waste 1(a) and 1(b) is dumped in the spoil pile and appears as strip 1(a) + 1(b) on the pile. The waste 2(a) and 2(b) appears as 2(a) + 2(b) as a strip in the spoil pile. The waste 3(a) and 3(b) is dumped in strip 3(a) + 3(b) in the pile.

The first excavated strip has a predetermined maximum width which in this example is shown as 60m and each subsequent strip mined in the method of the invention has a progressively narrower width until a predetermined minimum width strip is excavated. In this embodiment the minimum width strip has a width of 40m. Thus by progressively excavating smaller width strips the re-handling of waste with the dragline each time a strip is excavated is significantly reduced. Some re-handling is necessary after the predetermined minimum width strip is excavated and before a maximum width strip may once again be excavated and mined.

As shown in the figure part of portion 3(a) + 3(b) of waste shown shaded is removed and dumped further along in the spoil pile to make room for waste from the next strip of maximum width strip excavated in the method of the invention.

A bench is formed in the spoil pile and the spoil pullback of some of waste 3(a) + 3(b) is dumped further along the pile in area 44.

The benefits of the method of the invention in such double seam mining are:

spoil height reduction

a lower in pit bench

reduced second pass re-handling volume

manageable reach to the high wall

reduced high hoist/low productivity on the second pass

lower in pit bench results in less re-handling around ramps required to allow the dragline to walk to and along the bench.

Figures 24 and 25 are diagrammatic views illustrating the mining method of the invention as used in the double seam mining method just described.

A double pass with the dragline 35 is made to remove the overburden from the upper seam of coal. Topsoil is first removed with suitable equipment 50. The overburden is then drilled by a rig 51 to allow explosive charges to be positioned. The overburden is then blasted and the dragline 35 is used to expose the upper seam 52. A suitable loader 54 mines the coal and the coal is hauled by trucks 55 and transported to storage hoppers. Figure 25 illustrates the removal of the interburden so that the lower seam may be mined. The dragline 35 moves along the strip and dumps the interburden onto the spoil pile 56.

In the past mining of double seam with thick overburden and a thick interburden involved truck and shovel excavation of some of the overburden so that the thickness of the overburden remaining above the upper seam combined with the thickness of the interburden does not exceed the working capabilities of the dragline.

Constant width strips are excavated and not only is there considerable re-handling of waste by the dragline, the truck/shovel excavation may also be considerable.

Figure 26 is illustrative of what may be achieved by employing the method of the invention in a thick overburden, thick interburden situation for mining a double coal seam using a staggered stripping sequence. By excavating

a maximum width strip in sequence followed by progressively narrower width strips down to a minimum width and then once again excavating a wide strip, advantages are achieved. Dragline excavation is maximised and major dragline re-handling is managed so that it occurs after the minimum width strip is excavated and mined rather than during excavation of each strip, as was previously the case.

In addition truck/shovel removal of overburden may be minimised and limited so that a larger overburden thickness remains above the upper seam. This greater quantity of overburden may be more efficiently removed with the dragline rather than by truck and shovel excavation. In the figure, typically 30m of overburden 60 remains after some of the overburden 61 is removed by truck and shovel excavation. This thickness of 30m is given by way of example only. The actual depth is dependant upon the particular dragline employed. The upper seam 62 in this figure is separated from the lower seam 63 by 45m of interburden 64. The mining method of the invention involves multiple passes of the dragline to remove overburden from above seam 62 in a maximum strip width of say 60m to allow the coal in seam 62 to be removed. The interburden 64 is then removed in multiple passes of the dragline once again in a 60m strip width to expose seam 63. The coal in seam 63 is then removed. Progressively narrower strips of say 50m then 40m widths are then excavated and the coal mined before another wide strip is excavated. In the second wide strip (and subsequent wide strips) a substantial quantity of waste in strip 61a is removed with truck/shovel excavation.

Figure 27 is useful in understanding an alternative embodiment of the mining method of the invention for mining a dual seam coal deposit having thick overburden and a thick interburden. Progressively narrower strips are excavated and the strips above the upper seam are staggered relative to the strips excavated from above the lower seam 71.

As shown in Figure 27 portion 72 of the strip of maximum width above seam 70 is removed by truck/shovel excavation after blasting above the upper and lower seams in the maximum width staggered 60m strips. A suitable conventional dragline method can then be employed to remove waste 75 above

seam 70 and waste 74 above the lower seam 71. This will involve several dragline passes and necessary re-handling due to the staggered strip arrangement. The waste is dumped on the spoil pile 73. This process is continued until the minimum width strip 76 is reached. An increased amount of this strip 76 is excavated shown in this case excavated completely employing truck/shovel excavation and the waste is removed and not added to the spoil pile. The dragline is used to excavate waste 77 and any remaining waste 76 as predetermined and this waste is dumped on the spoil pile. Since waste 76 is trucked away a maximum width strip may then be excavated and the waste dumped onto the spoil pile. In this embodiment no major dragline spoil re-handling is necessary. The staggered arrangement allows both seams to be exposed and mined together. With this method there is less truck/shovel pre strip excavation than that necessary with known methods and a maximum dragline depth of approximately 75m is achieved.

The invention by reduction of re-handling of waste and reduced spoil pile height allows draglines to excavate to a greater depth.

The claims defining the invention are as follows:

1. A strip mining overburden removal method for use in strip mining of single or multiple seam deposits, the method including excavating waste with a dragline from a strip of predetermined maximum width in one or more passes of the dragline along the strip and dumping the waste into a previously mined strip to build a spoil pile, mining a deposit or deposits in the strip exposed by excavating the waste, excavating waste with the dragline from subsequent strips of progressively narrower width and dumping the waste into an adjacent previously mined strip to build a spoil pile and mining the deposit or deposits from the strips and, after a predetermined minimum width strip is excavated either by the dragline and/or by truck and shovel and mining coal or coal and partings from the minimum width strip, excavating a further strip of a predetermined maximum width and dumping the waste into the previously mined strip.

2. The method of claim 1 including major re-handling of waste in the spoil pile by the dragline after the minimum width strip has been excavated.

3. The method of claim 2 including re-handling of waste by the dragline during excavation of waste from the subsequent maximum width strip.

4. The method of claim 1 including removing waste from the spoil pile using any predetermined waste removal technique.

5. The method of claim 4 wherein top soil and/or some of the overburden is removed prior to excavating strips with the dragline.

6. The method of claim 4 or 5 for mining a multiple deposit seam having a thick overburden and a thin interburden, the method including removing some of the overburden so that the thickness of the interburden combined with the thickness of the remaining overburden does not exceed the maximum thickness of waste which may be excavated by the dragline.

7. The method of claim 6 including building of in-pit benches on which the dragline may work while excavating a strip.

8. The method of claim 2 wherein part of the re-handling of waste before a further strip of predetermined maximum width is excavated involves major spoil re-handling to provide room in the spoil pile for waste from the further strip of said

predetermined maximum width.

9. The method of claims 4 or 5 for mining a multiple deposit seam having a thick overburden and a thick interburden, the method including removing some of the overburden with truck and shovel excavation so that the combined thickness of the interburden and the remaining overburden in the strips excavated by the dragline does not exceed the maximum thickness of waste which may be excavated by the dragline and a substantial quantity of overburden from strips of maximum width after a strip of said predetermined maximum width is removed by truck and shovel excavation and not placed in the spoil pile.

10. The method of claims 4 or 5 for mining a multiple seam deposit having thick overburden and thick interburden, the method including excavating staggered strips of waste from above an upper seam and lower seam of the dual seam deposit with the strips including an initial strip of predetermined maximum width and successively narrower strips followed by a further strip of said predetermined maximum width.

11. The method of claim 10 including removing some of the overburden from some of the strips with truck and shovel excavation so that the combined thickness of the remaining overburden and interburden does not exceed the maximum thickness of waste which may be excavated by the dragline.

12. The method of claim 10 or 11 wherein most or all of the waste in the minimum width strip above the upper seam is removed by truck and shovel excavation.

13. The method of claims 10, 11 or 12 wherein the dragline used to excavate waste works from on top of the waste over the lower seam and removes waste from above the lower seam and from above the upper seam employing dragline digging to simultaneously expose the deposit in both seams as the dragline progresses along a strip.

14. The method of any one of claims 1 to 13 wherein between 2 to 5 strips of progressively narrower width are excavated after excavation of a maximum width strip and before a further maximum width strip is once again excavated.

15. The method of any one of claims 1 to 14 wherein the width difference between adjacent strips is between 5m to 15m.

16. The method of any one of claims 1 to 15 wherein the strips of maximum width are between 60m to 80m wide.

17. The method of any one of claims 1 to 16 wherein the minimum width strips are at least 30m wide.

18. A method of strip mining substantially as herein described with reference to Figures 1 to 22, Figures 23 to 25, Figure 26 or Figure 27 of the drawings.

DATED THIS 25TH DAY OF JUNE 1999

THIESS CONTRACTORS PTY LIMITED

BY THEIR PATENT ATTORNEYS

CULLEN & CO

1127

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	3097.0	27.4%	28.0%	36.0 deg	BLASTED

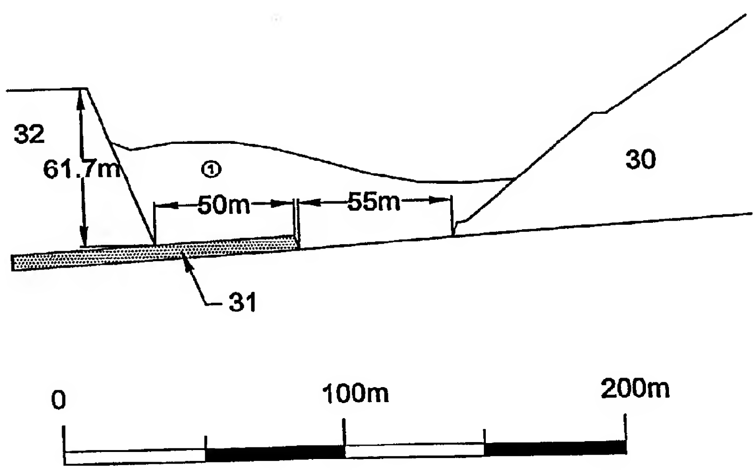

FIGURE 1

2127

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	157.1	27.4%	28.0%	36.0 deg	BLASTED

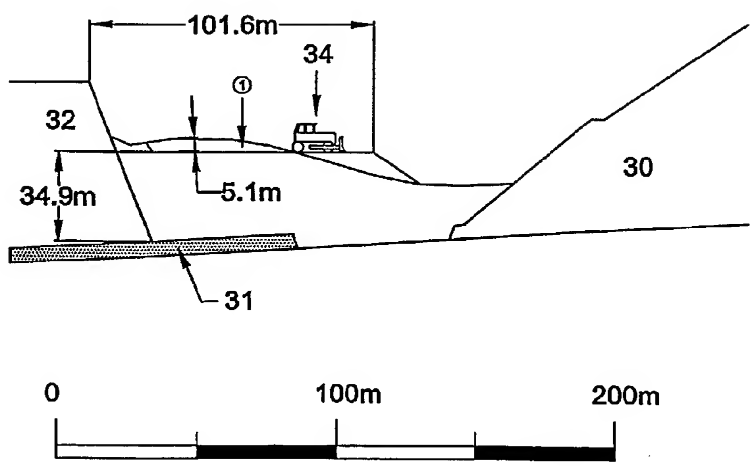

FIGURE 2

3127

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	1196.1	27.4%	28.0%	36.0 deg	BLASTED

DRAGLINE: DRAG 1	OP RAD: 84
DUMP HT: 43	SWING ANGLE SHOWN: 90

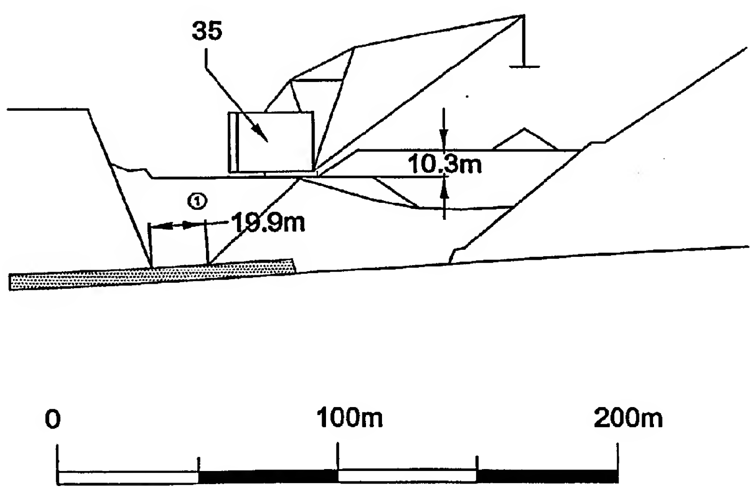

FIGURE 3

4127

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	257.6	28.0%	28.0%	36.0 deg	DL RE-HANDLE
②	121.7	28.0%	28.0%	36.0 deg	DOZER SPOIL
③	757.4	27.4%	28.0%	36.0 deg	BLASTED
④	34.2	28.0%	28.0%	36.0 deg	DOZER SPOIL
⑤	986.7	27.4%	28.0%	36.0 deg	BLASTED

DRAGLINE: DRAG 1 OP RAD: 84
DUMP HT: 43 SWING ANGLE SHOWN: 90

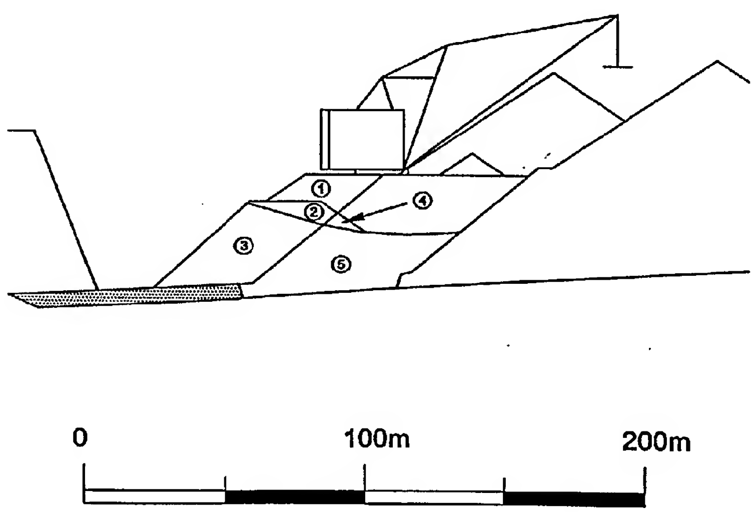

FIGURE 4

5127

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	2887.9	27.9%	28.0%	36.0 deg	BLASTED

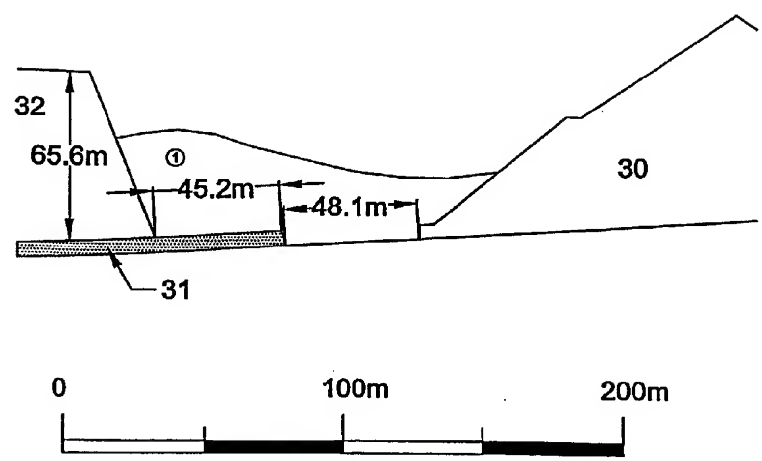

FIGURE 5

6\27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	144.4	27.9%	28.0%	36.0 deg	BLASTED

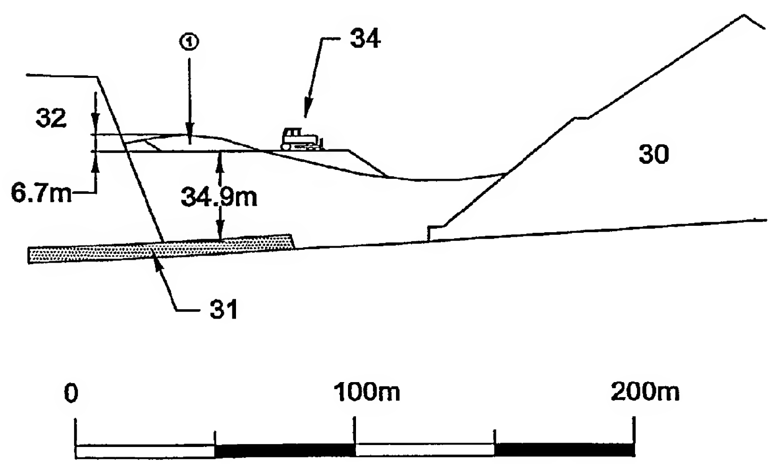

FIGURE 6

7|27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	127.0	27.9%	28.0%	36.0 deg	BLASTED

DRAGLINE: DRAG 1   OP RAD: 84
DUMP HT: 43   SWING ANGLE SHOWN: 90

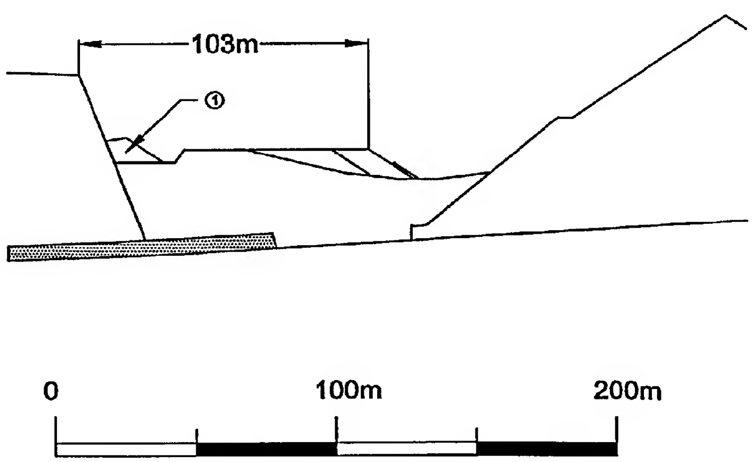

FIGURE 7

8\27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	1071.5	27.9%	28.0%	36.0 deg	BLASTED
②	31.8	28.0%	28.0%	36.0 deg	DOZER SPOIL

DRAGLINE: DRAG 1	OP RAD: 84
DUMP HT: 43	SWING ANGLE SHOWN: 90

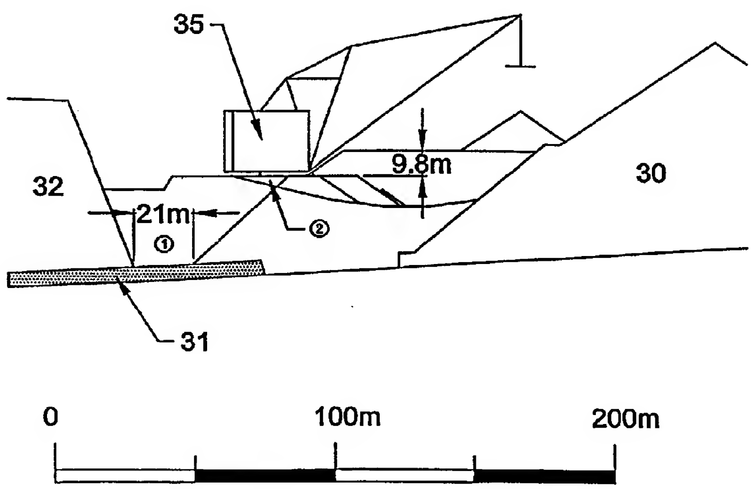

FIGURE 8

9127

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	190.9	28.0%	28.0%	36.0 deg	DL RE-HANDLE
②	57.7	28.0%	28.0%	36.0 deg	DL RE-HANDLE
③	108.9	28.0%	28.0%	36.0 deg	DOZER SPOIL
④	597.2	27.9%	28.0%	36.0 deg	BLASTED
⑤	949.1	27.9%	28.0%	36.0 deg	BLASTED

DRAGLINE: DRAG 1 OP RAD: 84
DUMP HT: 43 SWING ANGLE SHOWN: 90

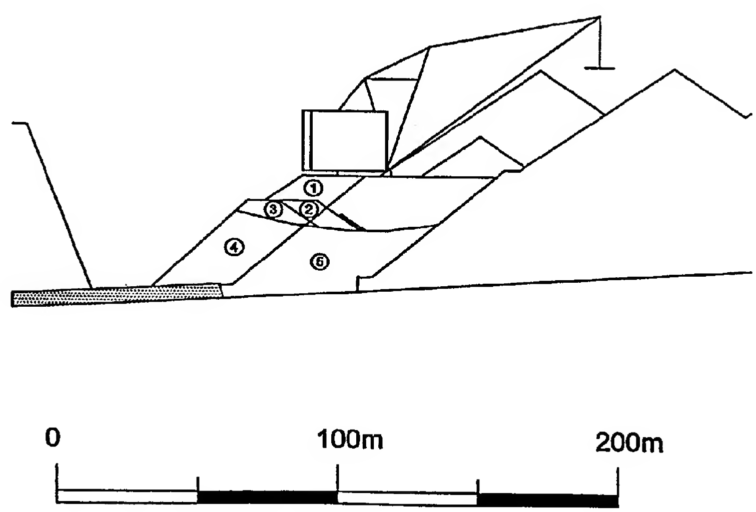

FIGURE 9

10\27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	2687.5	28.3%	28.0%	36.0 deg	BLASTED

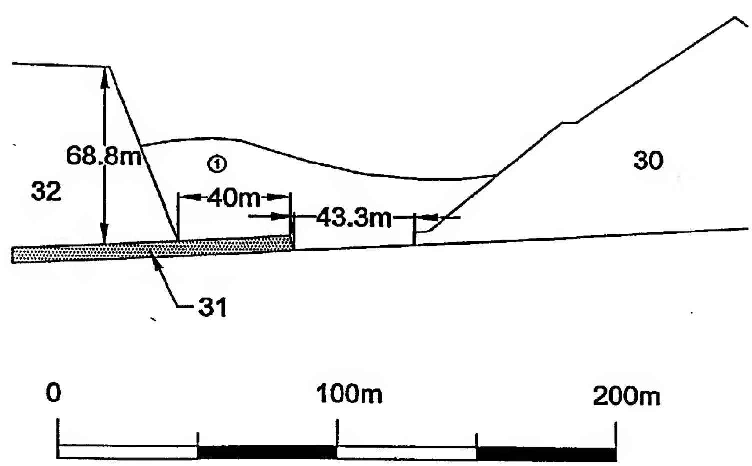

FIGURE 10

11\27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	123.1	28.3%	28.0%	36.0 deg	BLASTED

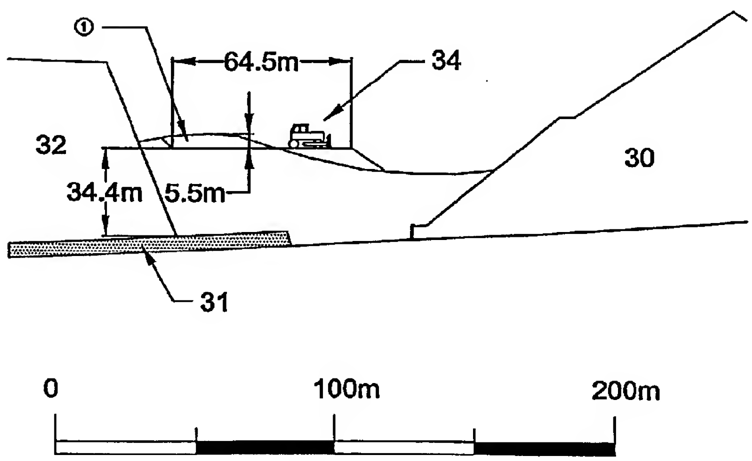

FIGURE 11

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DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	122.6	28.3%	28.0%	36.0 deg	BLASTED

DRAGLINE: DRAG 1	OP RAD: 84
DUMP HT: 43	SWING ANGLE SHOWN: 24

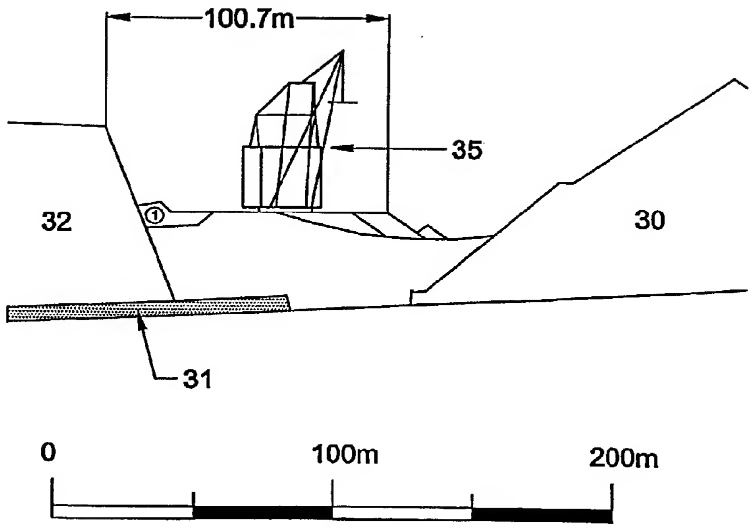

FIGURE 12

13|27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	1013.9	28.3%	28.0%	36.0 deg	BLASTED
②	30.1	28.0%	28.0%	36.0 deg	DOZER SPOIL

DRAGLINE: DRAG 1	OP RAD: 84
DUMP HT: 43	SWING ANGLE SHOWN: 90

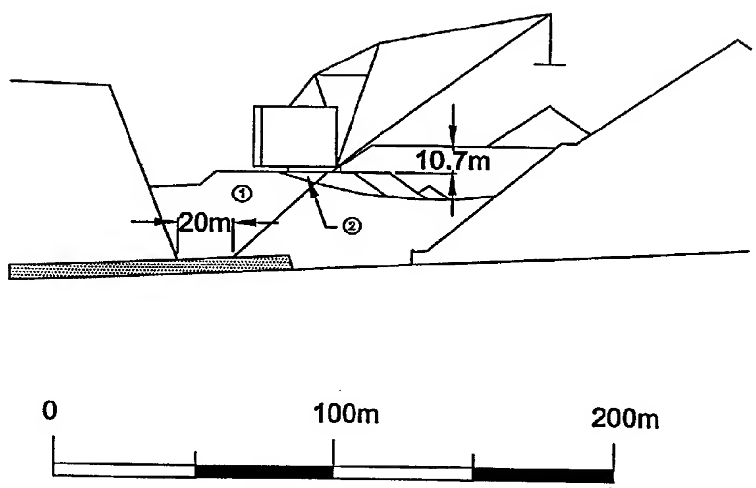

FIGURE 13

14 | 27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	211.3	28.0%	28.0%	36.0 deg	DL RE-HANDLE
②	48.3	28.0%	28.0%	36.0 deg	DL RE-HANDLE
③	90.3	28.0%	28.0%	36.0 deg	DOZER SPOIL
④	523.6	28.3%	28.0%	36.0 deg	BLASTED
⑤	903.5	28.3%	28.0%	36.0 deg	BLASTED

DRAGLINE: DRAG 1   OP RAD: 84
DUMP HT: 43   SWING ANGLE SHOWN: 90

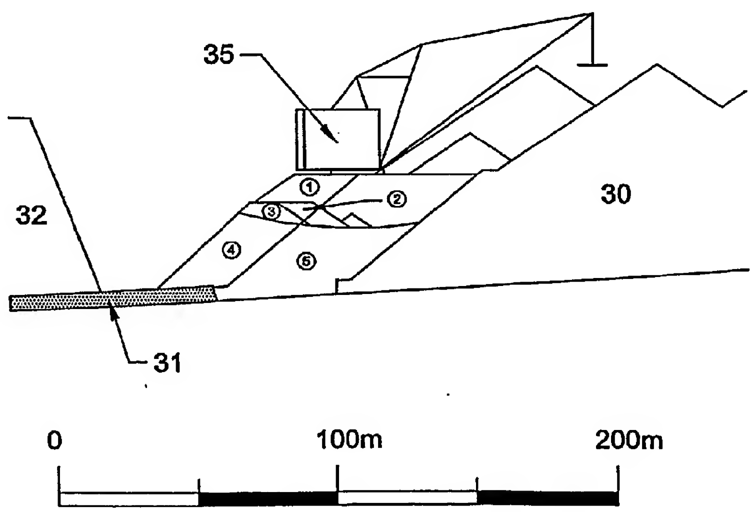

FIGURE 14

15|27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	66.7	0.0%	0.0%	36.0 deg	OLD SPOIL
②	89.3	0.0%	0.0%	36.0 deg	OLD SPOIL

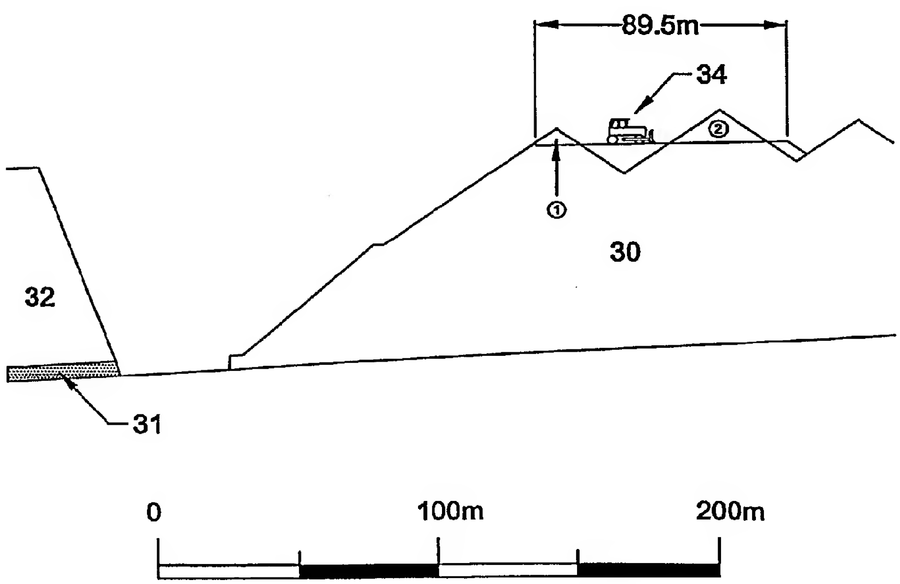

FIGURE 15

16|27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	2283.7	0.0%	0.0%	36.0 deg	OLD SPOIL
②	90.3	0.0%	0.0%	36.0 deg	DOZER SPOIL

DRAGLINE: DRAG 1 OP RAD: 84
DUMP HT: 43 SWING ANGLE SHOWN: 90

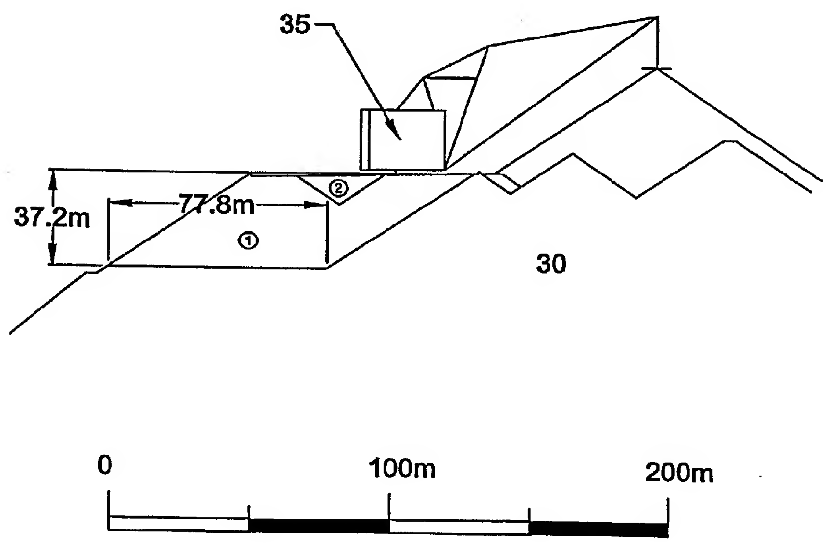

FIGURE 16

17|27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	4264.9	28.0%	28.0%	36.0 deg	BLASTED

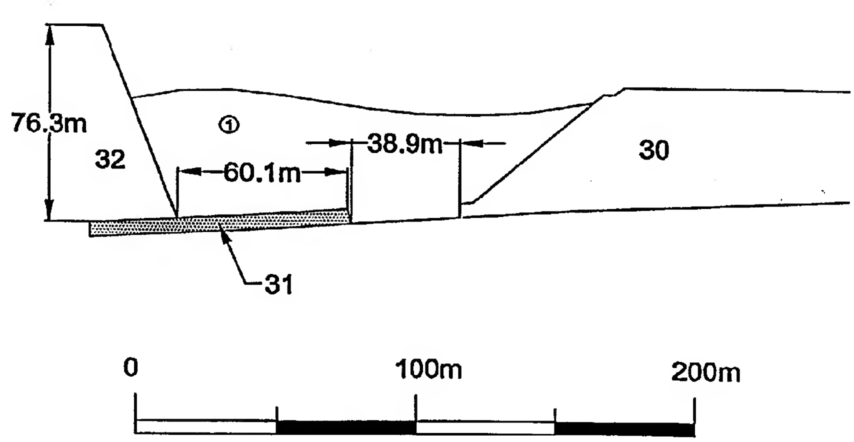

FIGURE 17

18127

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	155.6	28.0%	28.0%	36.0 deg	BLASTED

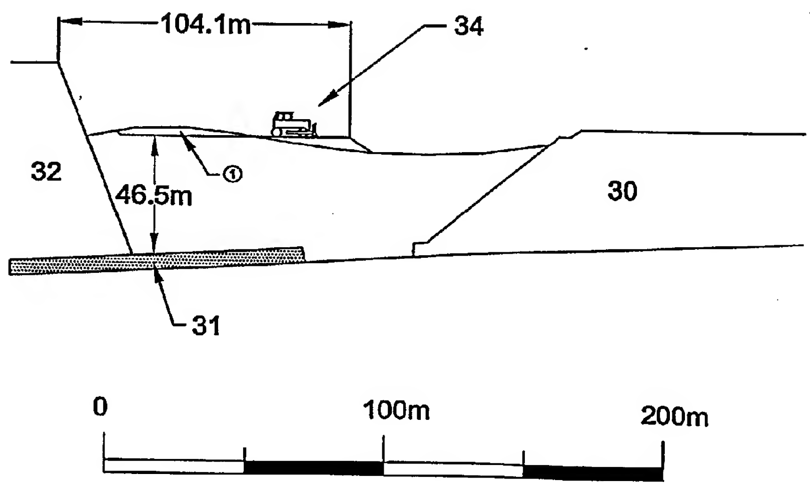

FIGURE 18

19|27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	2033.2	28.0%	28.0%	36.0 deg	BLASTED
②	76.8	28.0%	28.0%	36.0 deg	DOZER SPOIL

DRAGLINE: DRAG 1	OP RAD: 84
DUMP HT: 43	SWING ANGLE SHOWN: 90

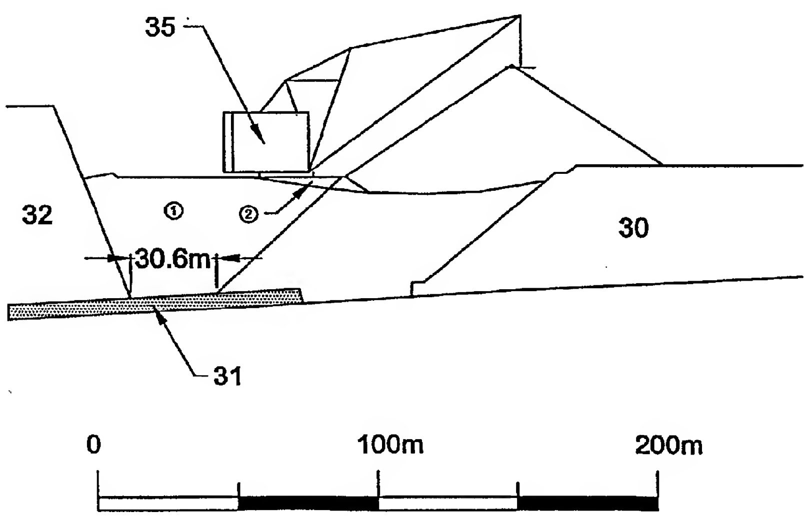

FIGURE 19

20\27

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	1646.2	28.0%	28.0%	36.0 deg	DL RE-HANDLE

DRAGLINE: DRAG 1	OP RAD: 84
DUMP HT: 43	SWING ANGLE SHOWN: -90

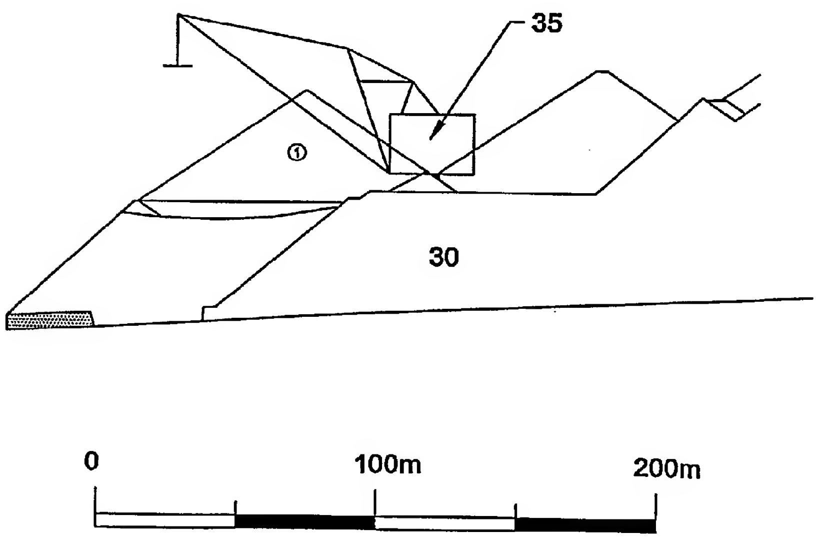

FIGURE 20

21127

DESIGNATOR	BANKED AREA	CURRENTLY SWELLED BY	MAXIMUM SWELL	REPOSE ANGLE	AREA TYPE
①	173.3	28.0%	28.0%	36.0 deg	DL RE-HANDLE
②	78.8	28.0%	28.0%	36.0 deg	DOZER SPOIL
③	913.8	28.0%	28.0%	36.0 deg	BLASTED
④	1161.2	28.0%	28.0%	36.0 deg	BLASTED

DRAGLINE: DRAG 1 OP RAD: 84
DUMP HT: 43 SWING ANGLE SHOWN: 90

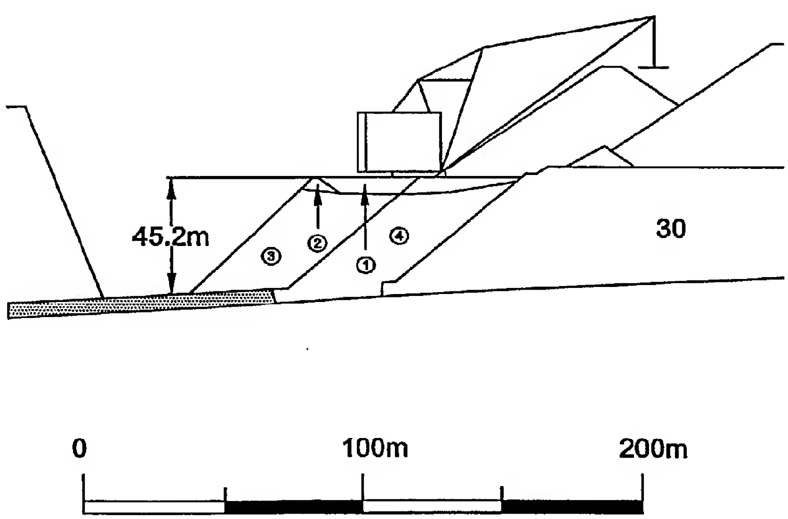

FIGURE 21

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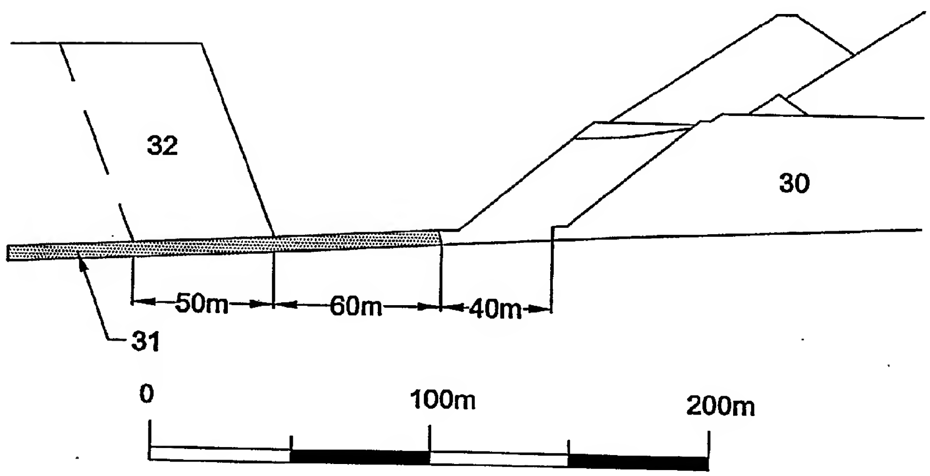

FIGURE 22

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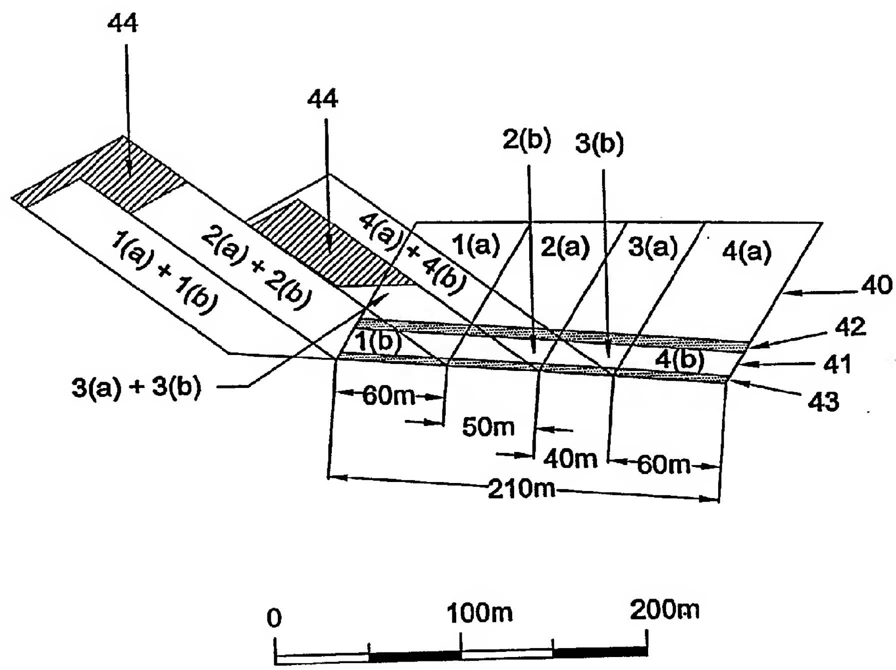

FIGURE 23

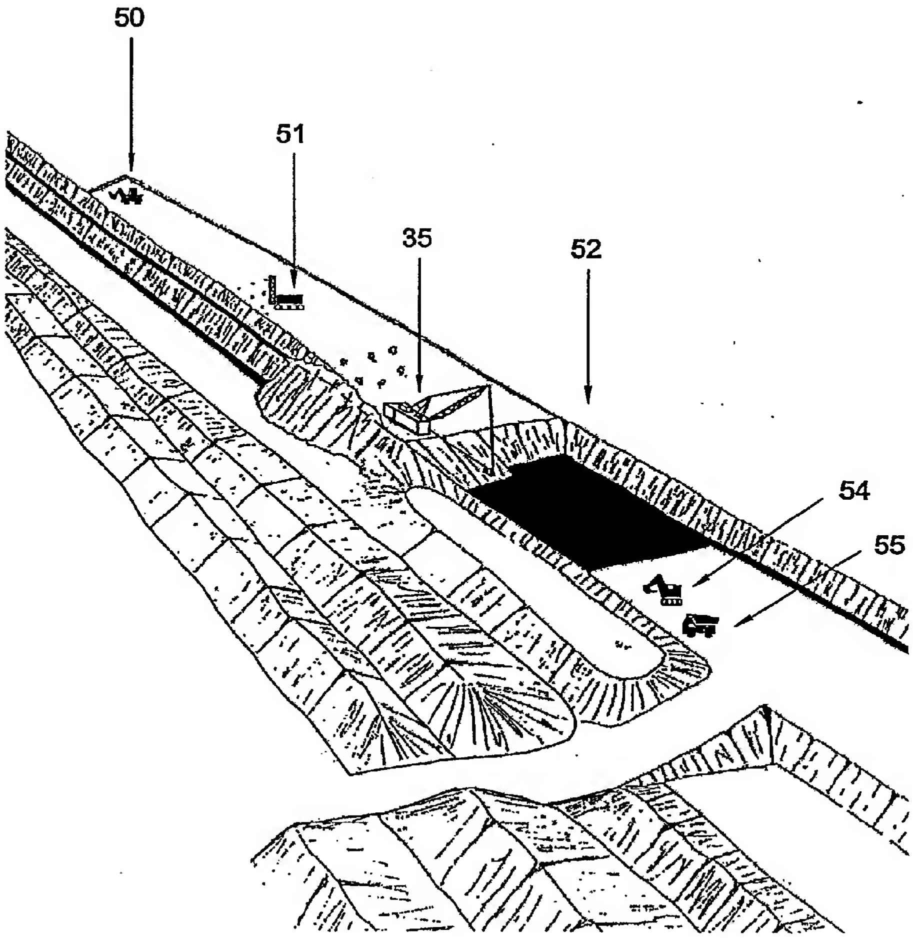

FIGURE 24

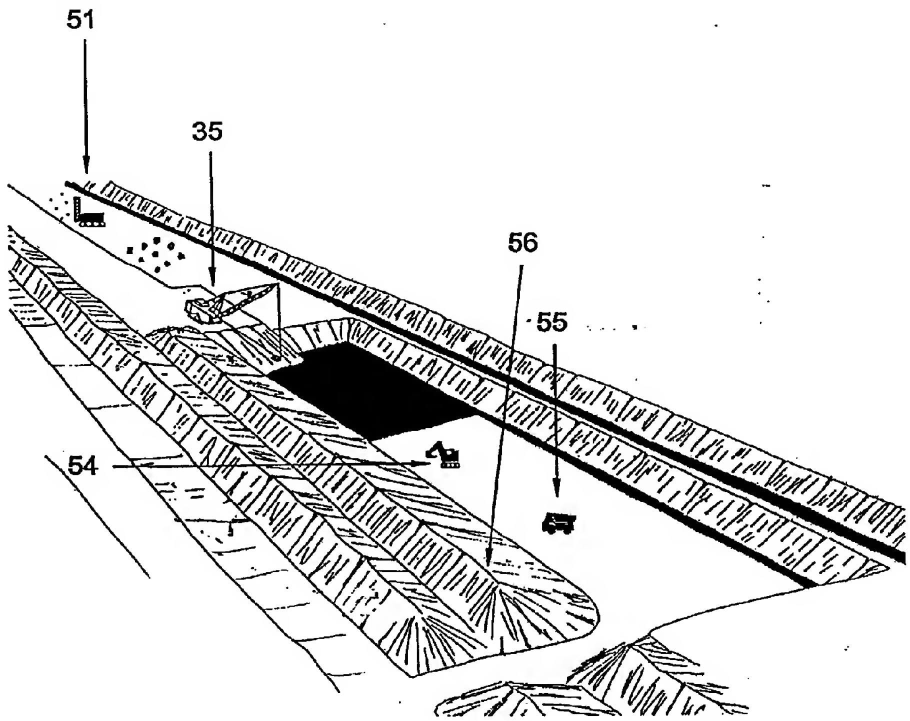

FIGURE 25

26|27

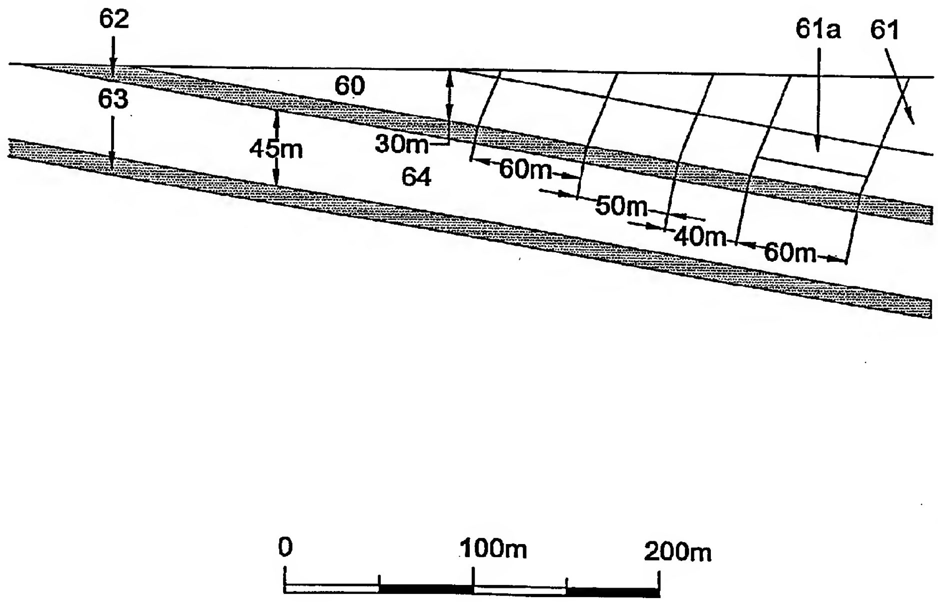

FIGURE 26

27|27

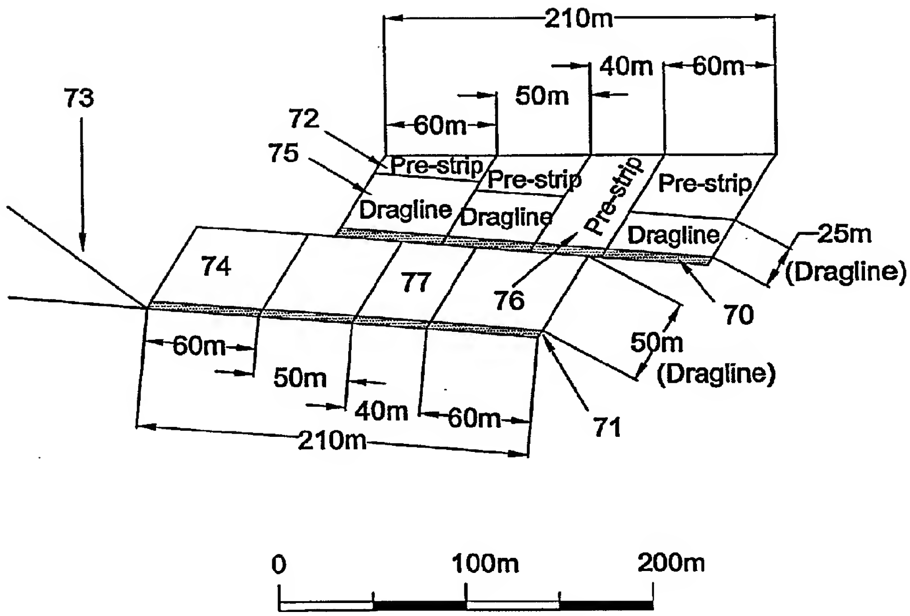

FIGURE 27